

REMARKS/ARGUMENTS

Reconsideration and allowance in view of the foregoing amendment and the following remarks are respectfully requested.

Claims 1-15 and 23 remain withdrawn from consideration. Claims 21 and 22 have been canceled above to avoid extra claims fees. Claims 16 and 17 have been amended above and claims 18-20 have been canceled. Also, new claims 24-26 have been added.

Claims 16-17 and 19 were rejected under 35 USC 102(b) as anticipated by Holzgrefe et al. Also claims 18 and 20 were rejected under 35 USC 103(a) as unpatentable over Holzgrefe. Applicant respectfully traverses these rejections.

It is an object of the invention to provide a fuel injection device which can improve atomization of fuel injected into respective cylinders of an engine. There are several ways to achieve this object, as disclosed in various embodiments of the present application. As understood from amended claim 16 and the new claim 26, one embodiment, disclosed with reference to elected Figures 18-20 has the following features, of which feature (e) is a particularly characteristic feature, which clearly differentiates the invention from the cited prior art, as discussed below:

(a) a space 180 is formed in an injection bore member 160, which is operatively communicated with a fuel passage 53, so that fuel is supplied into the space 180 when the fuel passage 53 is opened.

(b) a guide passage 171 having a center opening and a pair of outer openings is formed in the injection bore member 160, the center opening being arranged at a center of the injection bore member 160 and the outer openings being connected to the center opening and arranged at radial outer sides of the center opening.

(c) a pair of through-holes 165,166 is further formed in the injection bore member 160 for communicating the space 180 with the respective outer openings of the guide passage 171, so that the fuel flows from the space 180 into the outer openings of the guide passage 171 through the respective through-holes 165,166.

(d) multiple injection bores 168 are formed in the injection bore member 160, an inside end of each injection bore being opened to the center opening of the guide passage 171.

(e) each of the through-holes 165,166 is arranged at such a position, which is on an outer side of the injection bores 168 in a radial direction, so that the fuel supplied into the outer opening flows toward the injection bores 168 in radial and inward directions from each of the outer openings.

In an embodiment shown in Figures 1 to 3, Holzgrefe teaches outlet orifices formed in a lower functional level 35, inner ends of which are opened to a channel 41 formed in a functional level 36. An inlet orifice 40 is formed in an upper functional level 37, wherein the inlet orifice 40 has three inlet regions 46 and necks 45. In the orifice plate 23 of Holzgrefe, fuel flows into the orifice plate 23 through the inlet orifice 40, and flows to the outlet orifice 42 through the channel 41.

The channel 40 of Holzgrefe corresponds to the guide passage 171 of the invention, and the inlet orifice 40 of Holzgrefe corresponds to the through-holes 165,166 of the invention. As can be seen from Figure 2a of Holzgrefe, the inlet orifice 40 has three inlet regions 46 and two necks 45 between the inlet regions. It is apparent that the fuel flows into the channel 41 through inlet regions 46 and 45.

As is further apparent from Figure 2 of Holzgrefe, the inlet orifice 40 is offset from the outlet orifices 42. However, the inlet orifice 40 (the outer two regions 46) is formed not only at such a position, which is on an outer side of the outlet orifice 42 in a radial direction, but also at such a position (a middle inlet region) which is on an inner

side of the outlet orifices 42 in a radial direction. Accordingly, the fuel from the inlet orifice 40 flows in channel 41 toward the respective outlet orifices 42, as indicated by arrows in the attached annotated copy of Figure 2 of Holzgrefe et al.

According to the present invention, each of the through-holes 165,166 is arranged at such a position, which is on an outer side of the injection bores 168 in a radial direction. As is clearly shown in Figure 21 of applicant's disclosure, the fuel supplied into the outer openings of the guide passage 171 flows toward the injection bores 168 in radial and inward directions from each of the outer openings. Therefore, the fuel flow in an upper direction (in Figure 21) hits upon another fuel flow in a down direction, so that the fuel circulates around each of the injection bores 168.

Thus, the present invention is different from Holzgrefe in terms of the feature (e) above.

As indicated in the attached annotated copy of Figure 2 of Holzgrefe, the fuel flows f1, f2, and f3 may (or may not) hit against each other. However, according to the structure of the present invention, a much stronger hit of the fuel flows can be realized than with Holzgrefe, because at least two fuel flows are generated in the guide passage 171 in such a way that the fuel flows from the outer opening to the center opening in the radial and inward direction and two fuel flows hit against each other in the center opening, as shown in applicant's Figure 21.

As is apparent from the foregoing, the invention defined in claim 16 as well as claim 26 is neither anticipated by nor obvious from Holzgrefe.

On page 3 of the Office Action, with regard to claim 17, the Examiner said "the guide passage has a reducing area portion (45) whose area is gradually smaller toward the center thereof...".

The reducing area portion and the enlarging area portion of claim 17 of the invention are formed in the guide passage 171, which corresponds to the channel 41

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formed in the functional level 36 of Holzgrefe. The remaining area portion 45 pointed out by the Examiner, is the neck 45 formed in the upper functional level 37. Therefore, the neck 45 does not correspond to the reducing area of the invention as defined in claim 17.

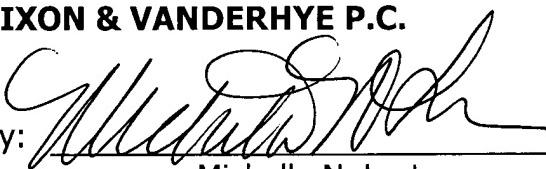
Accordingly, the invention of claim 17 is neither anticipated by nor obvious over the cited reference of Holzgrefe either.

In view of the foregoing, reconsideration and withdrawal of the rejection based on Holzgrefe is solicited.

All objections and rejections having been addressed, it is respectfully submitted that the present application is in condition for allowance and an early Notice to that effect is earnestly solicited.

Respectfully submitted,

NIXON & VANDERHYE P.C.

By: 
Michelle N. Lester
Reg. No. 32,331

MNL:slj
901 North Glebe Road, 11th Floor
Arlington, VA 22203-1808
Telephone: (703) 816-4000
Facsimile: (703) 816-4100

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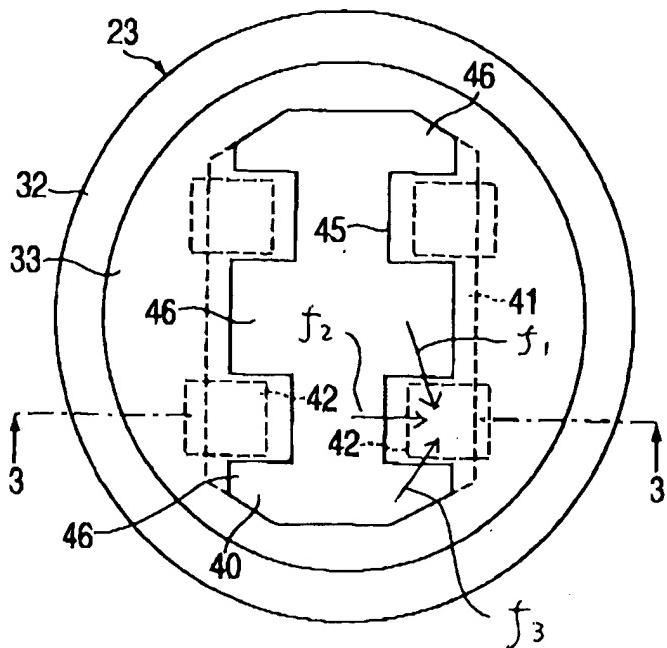


FIG. 2

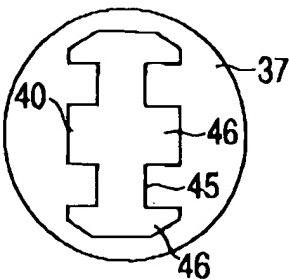


FIG. 2a

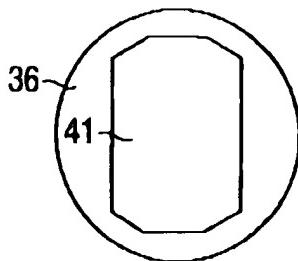


FIG. 2b

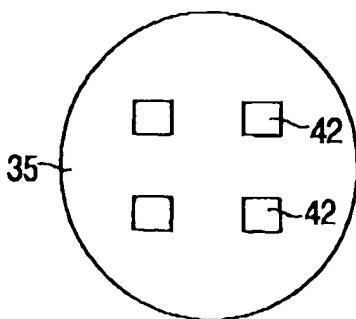


FIG. 2c

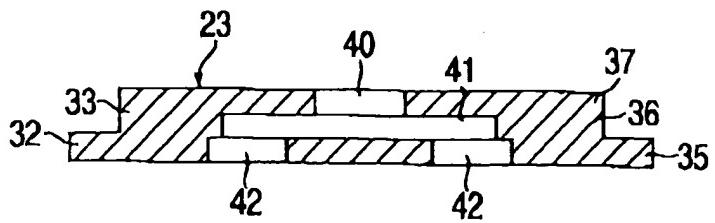


FIG. 3